

VOLUME LOSS CAUSED BY FUSIFORM RUST IN SLASH PINE PLANTATIONS
IN CENTRAL ~~LOUISIANA~~

by

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ABSTRACT

A small but significant (.025 level) difference in height was demonstrated in 15- and 20-year-old slash pine plantations between trees with 50 percent or greater fusiform rust stem girdles and non-stem-cankered living trees. Loss of wood fibre volume resulting from decreased height growth amounted to approximately 0.4 cords per acre. Rust mortality reached 19 percent in 14-year-old plantations and 17 percent in 9-year-old plantations. Eighteen percent of the trees in the 5-year-old plantings had died from rust. The greatest number of stem cankers were observed in the 9- and 14-year-olds (42 and 43 percent, respectively), while the 7-year-olds had the most frequent branch cankering (18 percent). Multiple-stemmed trees were most common in the 6-year-old plantations (13 percent).

INTRODUCTION

Although mortality caused by fusiform rust has been shown to result in volume loss in slash pine, little research has been reported in which the effect of rust on volume loss in living trees is shown. Rust has no impact on the diameter of infected trees and attacks all diameter classes equally with regard to severity of attack or numbers of trees (Froelich, Nance, and Shoulders, personal comm.) They did not investigate the effect of rust infection on height growth.

MATERIALS AND METHODS

Following fusiform rust surveys of 1971-73, plantations of slash pine in central Louisiana were selected for a volume loss evaluation in high rust hazard areas. Six row plots, spaced systematically over the plantation, were selected. Each row plot had 100 trees in it. Stocking of the plantation had to be at least 80 percent 1 year after planting. Rust condition class of each tree and the position of each empty

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planting space were recorded. Diameter, form class, and height measurements were taken in the 15- and 20-year-age classes to allow volume determinations to be made. Trees with 50 percent or greater stem girdles were recorded in these age classes in 1979. Four plantations in each of six age classes (1, 2, 3, 5, 10, and 15 years) in 1974 were observed. The evaluation was initially planned to continue for 5 years in five central Louisiana parishes. Data were collected annually. During this time, one and one-half plantations in the oldest age class were thinned. Two rows of a 1-year-old plantation were lost to fire. Otherwise, plots remained intact.

In the sixth year of the evaluation, diameters and heights taken with stem calipers and clinometer were tallied for three trees in each of two condition classes within all of the merchantable diameter classes (5 inches or greater). The condition classes were non-stem-cankered trees and trees having a 50 percent or greater stem-canker. Four 15-year-old and three 20-year-old plantations were observed.

Volume estimates were linearly interpolated from Minor's form class volume table.

Heights in this evaluation were not standardized as to location of the measured tree and the trees surrounding it. Thus, some spatial variation did occur.

RESULTS

An average loss of 1.33 feet in height for the 50 percent plus cankered trees was computed (t-test in table 1). This substantiates the unpublished findings of Mann and Derr who found a 1 to 1½ foot difference between stem-cankered and healthy trees in an 8-year-old slash pine plantation in Rapides Parish.

This height loss would result in a wood fiber loss of approximately 0.4 cords per acre per 20-year rotation based on the number of merchantable stems present in these plantations.

Nonsignificant diameter differences between the two above condition classes were also detected. Data from the same three 20-year-old and four 15-year-old plantations were taken. In five of the seven plantations, the average diameter was larger for the non-stem-cankered than stem-cankered trees. A t-test, however, revealed no significant differences between the mean diameters in the two condition classes.

Table 1. Mean heights found for seven 15- and 20-year-old slash pine plantations. Student's t computations at bottom show a significant difference at the 2.5 percent level.

Diameter Class	Non-stem cankered	Stem cankered	Diff.	Diff. ²
5	41	39	2	4
6	44	42	2	4
7	48	46	2	4
8	51	51	0	0
9	53	53	0	0
10	59	57	2	4
\bar{n}	49.33	48.00	1.33	2.67
Total	296	288	8	16

\bar{x}_H - non-stem-cankered

\bar{x}_S - stem-cankered

$$S^2 = \frac{\sum (\text{Diff})^2 - (\sum \text{Diff})^2 / n}{n} = 1.066, S = 1.032$$

$$S_{\bar{x}} = S / \sqrt{n} = .42$$

$$t = (\bar{x}_H - \bar{x}_S) / S_{\bar{x}} = 3.167$$

$$t_{.025} = 3.163$$

Unless a 2½ chance out of 100 occurred, \bar{x}_H is significantly different than \bar{x}_S

Condition class in the winter of 1977-78 was recorded for all but the oldest age class. Refer to table 2 for results.

Table 2. Percent fusiform rust cankering of five age classes (four plantations per age class) of slash pine plantations in central Louisiana (winter 1977-78)

Age class (yrs)	Healthy	Condition Class (Percent)			Multiple terminal	Dead-Other
		Stem	Branch	Dead-Rust		
5	25	15	12	18	9	23
6	29	34	9	9	13	10
7	34	29	18	9	5	7
9	26	42	12	17	1	3
14	25	43	14	19	1	1

Note the high amount of rust associated mortality (RAM) occurring in the 5-, 9-, and 14-year age classes. There is also a large amount of stem-cankering in both the 9- and 14-year age classes. Six-year-old trees showed the most multiple terminals resulting from rust infection. Finally, in addition to the large rust-caused mortality, other mortality is very large (23 percent) in the 5-year age class. Total mortality had reached 41 percent in this age class. The dead-other figure is large because of a fire which destroyed two rows (approximately 200 trees) and because plowing to prevent wildfire killed an additional 100 of 600 trees on two plantations.

Individual plantations in the 14-year-age group show high rust mortality figures (to 28 percent). One 9-year-old plantation contained 54 percent stem-cankered trees.

Selected 7-, 8-, 10-, and 15-year plantations were tallied for condition class in the winter of 1978-79. Refer to table 3.

Table 3. Rust condition class (percent) of selected slash pine plantations in central Louisiana (winter 1978-79)

Age Class	Healthy	Stem	Branch	Dead-Rust	Multiple Terminal	Dead/Other
7	35	28	7	7	21	4
8	27	40	8	19	6	3
10	25	38	10	25	0	5
10	23	45	8	24	1	1
11*	22	53	6	19	1	1
15	17	47	10	27	0	2
15	18	43	9	31	0	1

* Referred to in text as a 10-year-old plantation.

DISCUSSION

The 10-year-old plantations with a high percentage of stem-cankering (and RAM) are still 5 years away from thinning. RAM is even greater with the 15-year-olds; these stands badly need improvement cutting. Multiple terminals due to rust abound in the 7-year plantation. Stem-cankering and mortality are also great in the 8-year-old plantation.

It is difficult to measure volume loss caused by any disease in forest plantations. Fusiform rust is no exception. Volume impact could not be demonstrated in comparisons between an ideal survival model and the present evaluation. Control of the disease with systemics may be the only way to assess volume loss (Froelich, personal communication). The Southern Forest Experiment Station at Gulfport, Mississippi, is in the preliminary stages of such a study.

While wood fiber volume loss resulting from rust may be larger in slash pine, loblolly pine may be a greater problem when sawtimber or veneer are desired. This is because loblolly is less easily killed, and therefore timber volume and quality loss may be greater with this species (Nance, personal communication).

Further analysis of these data is continuing. A case history is being compiled for slash pine plantations on high-hazard sites in Louisiana. Also, data collected on 5-year-old plantations is being incorporated into an evaluation of a slash pine survival model proposed by Warren Nance (USDA, FS, Research, Gulfport, Miss.). It is expected that these evaluations will result in an effective tool for the manager of slash pine in the southeast.

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